

# ATENT COOPERATION TR' TY

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner  
US Department of Commerce  
United States Patent and Trademark  
Office, PCT  
2011 South Clark Place Room  
CP2/5C24  
Arlington, VA 22202  
ETATS-UNIS D'AMERIQUE  
in its capacity as elected Office

<b>Date of mailing (day/month/year)</b> 28 May 2001 (28.05.01)	<b>Applicant's or agent's file reference</b> 13436PCT.jdg
<b>International application No.</b> PCT/GB00/03751	<b>Priority date (day/month/year)</b> 01 October 1999 (01.10.99)
<b>International filing date (day/month/year)</b> 29 September 2000 (29.09.00)	
<b>Applicant</b> POWELL, Kevin, Mark	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

24 April 2001 (24.04.01)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

<p>The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland</p> <p>Facsimile No.: (41-22) 740.14.35</p>	<p>Authorized officer Olivia TEFY</p> <p>Telephone No.: (41-22) 338.83.38</p>
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**Application No:** GB 9915586.3  
**Claims searched:** all

**Examiner:** R C Squire  
**Date of search:** 22 September 1999

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): F3A

Int Cl (Ed.6): F42B; F42D

Other: Online:WPI, EPODOC

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
X	GB 1084972 ✓ HARVEY (see particularly page 3 lines 34-39, 59, 60)	1,2
X	GB 0852428 ✓ JERSEY (see particularly page 3 lines 15-23)	1,2
A	WO 80/01511A SCHROCKSNADEL	

X Document indicating lack of novelty or inventive step  
Y Document indicating lack of inventive step if combined with one or more other documents of same category.

& Member of the same patent family

A Document indicating technological background and/or state of the art.  
P Document published on or after the declared priority date but before the filing date of this invention.  
E Patent document published on or after, but with priority date earlier than, the filing date of this application.

## PATENT COOPERATION TREATY

PCT

NOTIFICATION CONCERNING  
SUBMISSION OR TRANSMITTAL  
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

From the INTERNATIONAL BUREAU

To:

GREENWOOD, John, David  
Graham Watt & Co.  
Riverhead  
Sevenoaks  
Kent TN13 2BN  
ROYAUME-UNI

Date of mailing (day/month/year) 21 November 2000 (21.11.00)	<b>IMPORTANT NOTIFICATION</b>
Applicant's or agent's file reference 13436PCT.jdg	
International application No. PCT/GB00/03751	International filing date (day/month/year) 29 September 2000 (29.09.00)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 01 October 1999 (01.10.99)
Applicant POWELL, Kevin, Mark	

- The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
- This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.
- An asterisk(\*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
- The letters "NR" appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
01 Octo 1999 (01.10.99)	09/412,764	US	10 Nov 2000 (10.11.00)



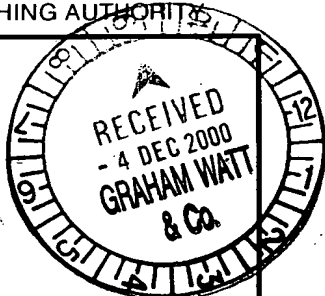
The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Magda BOUACHA
Facsimile No (41-22) 740.14.35	Telephone No. (41-22) 398.83.38

# PATENT COOPERATION TREATY

# PCT

From the INTERNATIONAL SEARCHING AUTHORITY

To:  
GRAHAM WATT & CO.  
Attn. GREENWOOD, J.D.  
Riverhead  
Sevenoaks  
Kent TN13 2BN  
UNITED KINGDOM



NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL SEARCH REPORT  
OR THE DECLARATION

(PCT Rule 44.1)

Date of mailing (day/month/year) 05/12/2000	
Applicant's or agent's file reference 13436PCT.jdg	<b>FOR FURTHER ACTION</b> See paragraphs 1 and 4 below
International application No. PCT/GB 00/ 03751	International filing date (day/month/year) 29/09/2000
Applicant  POWELL, Kevin, Mark	

1. ☒ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

**Filing of amendments and statement under Article 19:**

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

**When?** The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

**Where?** Directly to the International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland  
Facsimile No.: (41-22) 740.14.35

**For more detailed instructions,** see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.


☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority  European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer  Germaine Moet
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## NO TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

### INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

#### What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

#### When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

#### Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

#### How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

#### What documents must/may accompany the amendments?

##### Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:  
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:  
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:  
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or  
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:  
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

**"Statement under article 19(1)" (Rule 46.4)**

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

**It must be in the language in which the international application is to be published.**

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

**Consequence if a demand for international preliminary examination has already been filed**

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

**Consequence with regard to translation of the international application for entry into the national phase**

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>13436PCT.jdg</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/GB 00/ 03751</b>	International filing date (day/month/year) <b>29/09/2000</b>	(Earliest) Priority Date (day/month/year) <b>01/10/1999</b>
Applicant <b>POWELL, Kevin, Mark</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

## 1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☐ the text is approved as submitted by the applicant.

☒ the text has been established by this Authority to read as follows:

**HOLLOW CHARGE EXPLOSIVE DEVICE PARTICULARLY FOR AVALANCHE CONTROL**

5. With regard to the **abstract**,

☐ the text is approved as submitted by the applicant.

☒ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

**16** \_\_\_\_\_

☐ None of the figures.

**B x III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)**

Line 13: the part beginning with the words "A range of..." and ending in the words "is also disclosed." is deleted.;  
Instead: "Two of such charges with a conical liner can be positioned either facing each other or facing away from each other to obtain a particular blast pattern."



## INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/03751

A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 7 F42B1/032 F42B3/00 F42D3/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
 IPC 7 F42B F42D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	DE 11 36 920 B (BÖLKOW-ENTWICKLUNGEN) column 1, line 44 -column 3, line 2  column 3, line 59 -column 4, line 3; figure 3 ---	1-3,19 4-8,20, 21 14-16
X A	US 2 972 948 A (KRAY) 28 February 1961 (1961-02-28) column 2, line 15 - line 33; figure 1 ---	1-3  7,8,14, 21
X	FR 1 525 339 A (LACHAIZE) 5 September 1968 (1968-09-05) the whole document ---	1-3
X Y A	DE 11 30 746 B (RHEINMETALL) column 1, line 12 - line 26 column 2, line 28 - line 38; figures 1-3 --- -/--	1,2 4-8 14,21

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*G\* document member of the same patent family

Date of the actual completion of the international search

29 November 2000

Date of mailing of the international search report

05/12/2000

Name and mailing address of the ISA  
 European Patent Office, P.B. 5818 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
 Fax: (+31-70) 340-3016

Authorized officer

Giesen, M

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/03751

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CH 369 158 A (MESSERLI) 15 May 1963 (1963-05-15) page 1, left-hand column, line 1 - line 33	20,21
A	page 2, left-hand column, line 48 -right-hand column, line 72; figure 13 ----	14
A	DE 25 00 152 A (SOMEBOR) 10 July 1975 (1975-07-10) page 3, paragraph 5 -page 4, paragraph 2; claims 1-4; figure 1 ----	10,12
A	US 3 664 262 A (ROSE ET AL.) 23 May 1972 (1972-05-23) column 1, line 55 -column 2, line 42; claims 1,2,6; figures 1,2 ----	10,12,13
A	DE 23 06 889 A (ORSZAGOS KÖOLAJ ES GAZIPARI TRÖSZT) 22 August 1974 (1974-08-22) page 6, line 4 - line 16; figure 1 ----	11
A	FR 977 378 A (INST.OF INVENTIVE RESEARCH) 30 March 1951 (1951-03-30) page 3, right-hand column, line 21 -page 4, left-hand column, line 25; figures 2-4 ----	11
A	DE 38 34 491 A (MESSERSCHMITT-BÖLKOW-BLOHM) 12 April 1990 (1990-04-12) the whole document ----	17
A	US 4 187 782 A (GRACE) 12 February 1980 (1980-02-12) ----	
A	DE 34 05 527 C (MESSERSCHMITT-BÖLKOW-BLOHM) 5 June 1985 (1985-06-05) -----	

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/03751

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 1136920 . B		CH 374318 A FR 1283683 A	31-12-1963
US 2972948 A	28-02-1961	NONE	
FR 1525339 . A	05-09-1968	NONE	
DE 1130746 . B		FR 1273684 A GB 968507 A NL 257607 A	09-02-1962
CH 369158 . A	15-05-1963	NONE	
DE 2500152 . A	10-07-1975	FR 2256777 A	01-08-1975
US 3664262 A	23-05-1972	NONE	
DE 2306889 . A	22-08-1974	NONE	
FR 977378 . A	30-03-1951	NONE	
DE 3834491 . A	12-04-1990	NONE	
US 4187782 A	12-02-1980	NONE	
DE 3405527 . C	05-06-1985	NONE	

# PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

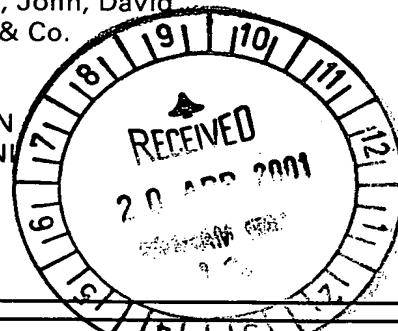
PCT

## NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:

GREENWOOD, John, David  
Graham Watt & Co.  
Riverhead  
Sevenoaks  
Kent TN13 2BN  
ROYAUME-UNI



IMPORTANT NOTICE

Date of mailing (day/month/year) 12 April 2001 (12.04.01)		
Applicant's or agent's file reference 13436PCT.jdg		
International application No. PCT/GB00/03751	International filing date (day/month/year) 29 September 2000 (29.09.00)	Priority date (day/month/year) 01 October 1999 (01.10.99)
Applicant POWELL, Kevin, Mark		

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:  
AU,KP,KR,US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:

AE,AG,AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,BZ,CA,CH,CN,CR,CU,CZ,DE,DK,DM,DZ,EA,EE,EP,ES,FI,GB,GD,GE,GH,GM,HR,HU,ID,IL,IN,IS,JP,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MA,MD,MG,MK,MN,MW,MX,MZ,NO,NZ,OA,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,TZ,UA,UG,UZ,VN,YU.  
The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on  
12 April 2001 (12.04.01) under No. WO 01/25717

### REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

### REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740.14.35	Authorized officer J. Zahra Telephone No. (41-22) 338.83.38
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# PATENT COOPERATION TREATY

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

# PCT

## NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Rule 71.1)

To:

GREENWOOD, J.D.  
GRAHAM WATT & CO.  
Riverhead  
Sevenoaks  
Kent TN13 2BN  
GRANDE BRETAGNE



Date of mailing  
(day/month/year) 14.12.2001

Applicant's or agent's file reference  
13436PCT

### IMPORTANT NOTIFICATION

International application No.  
PCT/GB00/03751

International filing date (day/month/year)  
29/09/2000

Priority date (day/month/year)  
01/10/1999

Applicant  
POWELL, Kevin, Mark

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

#### 4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/

 European Patent Office - P.B. 5818 Patentlaan 2  
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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 13436PCT		FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB00/03751	International filing date (day/month/year) 29/09/2000	Priority date (day/month/year) 01/10/1999	
International Patent Classification (IPC) or national classification and IPC F42B1/032			
Applicant POWELL, Kevin, Mark			

<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p><input type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of sheets.</p>
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li>I <input checked="" type="checkbox"/> Basis of the report</li> <li>II <input type="checkbox"/> Priority</li> <li>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li>IV <input type="checkbox"/> Lack of unity of invention</li> <li>V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li>VI <input type="checkbox"/> Certain documents cited</li> <li>VII <input checked="" type="checkbox"/> Certain defects in the international application</li> <li>VIII <input checked="" type="checkbox"/> Certain observations on the international application</li> </ul>

Date of submission of the demand 24/04/2001	Date of completion of this report 14.12.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized officer  Giesen, M  Telephone No. +31 70 340 3747



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/GB00/03751

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, pages:**

1-19 as originally filed

**Claims, No.:**

1-21 as originally filed

**Drawings, sheets:**

1/7-7/7 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

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☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes:	Claims	4-18,20,21
	No:	Claims	1-3,19
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-21
Industrial applicability (IA)	Yes:	Claims	1-21
	No:	Claims	

2. Citations and explanations  
**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:  
**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:  
**see separate sheet**



**Re Item V**

**Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. DE 1 136920 B (D1) describes a hollow charge explosive device including an explosive charge (10) which defines boundary walls of a cavity and including particulate material (17) located "forward" of said boundary walls so as to be dispersible by said explosive charge when detonated.

Consequently the subject matter of independent claim 1 is not new in the sense of Article 33(2) PCT.

2. Dependent claims 2 - 18 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step, the reasons being as follows:

The features of dependent claims 2 and 3 are known from D1.

The features of dependent claims 4 - 8 are evident from the combination of D1 and DE 1 130 746 B (D2).

The features of dependent claim 9 are obvious to the man skilled in the art of explosive devices.

The features of dependent claims 10 and 12 are known from DE 25 00 152 A (D3) and US 3 664 262 (D4).

The features of dependent claim 11 are known from DE 2 306 889 A (D5) and FR 977 378 A (D6).

The features of dependent claim 13 are known from D4.

The features of dependent claims 14 - 16 are known from or made evident by D1.

The features of dependent claim 17 are known from DE 38 34 491 A (D7).

The features of dependent claim 18 are obvious to the man skilled in the art of explosive devices.

3. The features of independent method claim 19 are known from D1.

Consequently the subject matter of independent claim 19 is not new in the sense of Article 33(2) PCT.

4. Dependent claims 20 and 21 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step, the reasons being as follows:

The features of dependent claims 20 and 21 are evident from the combination of D1 and CH 369 158 A (D8).

**Re Item VII**

**Certain defects in the international application**

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1, D2 and D8 is not mentioned in the description, nor are these documents identified therein.
2. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

**Re Item VIII**

**Certain observations on the international application**

1. The application does not satisfy the requirement of clarity of Article 6 PCT.

The expression "forward" is not clear, in particular in relation to the embodiment of figure 2.

7/parts

## HOLLOW CHARGE EXPLOSIVE DEVICE PARTICULARLY FOR AVALANCHE CONTROL

This invention relates to explosive devices commonly referred to as hollow charges or shaped charges. These essentially comprise a symmetric explosive charge within which is formed a cavity lined by a lining material. When the explosive charge is detonated the liner, of metal in known devices, is subject to extremely high compressive loads which act to collapse and eject the liner material in the form of a high speed fluid jet, normally followed by a more slowly moving rigid slug. The charge and liner may be rotationally symmetric or non axi-symmetric, for example with a liner with a "V" cross section, used for cutting operations.

There are a number of industrial applications for shaped charge devices where rapid penetration effects are required in awkward and inaccessible places. An example is to initiate or increase the yield of oil & gas wells. In this case a number of charges are arranged to fire radially outwards at the base of the well. Upon detonation the shaped charge jets perforate the steel well casing, surrounding concrete grouting and then penetrate deeply into the oil/gas bearing rock, producing a series of discrete channels through which the oil and gas can flow into the well conduit. Another application is perforation and clearance of refractory bung at the base of a steel smelting crucible. The most extensive use, however, is in the military context against heavily protected targets such

as tanks and shelters and for a wide range of battlefield engineering applications. In all these cases the shaped charges are designed and applied to exploit their penetration potential.

The present invention seeks to provide a shaped charge explosive device particularly suitable for use for avalanche control. However, the mechanism by which energy is distributed and imparted to the target medium by this invention offers potential for a number of alternative applications. The invention will be described in context with avalanche control applications first, followed by alternative applications.

Avalanches can present a serious danger to people and property when triggered in an uncontrolled manner, whether by a natural cause such as the weather conditions or unintentionally as a result of human activity such as skiing or climbing. It has therefore become an established practice in many mountainous areas to maintain a continuous programme of avalanche control using explosives to trigger a release. This practice of regularly triggering small controlled avalanches is intended to minimise the build up of snow in known start zones which, if left, would eventually release naturally and unexpectedly often cascading out of control. The current practices relevant to the present invention include the following.

Where avalanche start zones are inaccessible, an explosive charge can be delivered to the slope in the form of a projectile fired from a gun or mortar system where the

projectile explodes on or shortly after impact. Short ranges (up to 3km) can be covered by gas gun projector systems such as the nitrogen driven Avalauncher, used extensively in the US, Canada and Europe. Longer ranges demand high performance systems typical of military artillery and the 105mm howitzer and 106mm recoilless rifle have been used in avalanche control operations for many years.

Fuzes in older military ammunition are designed to detonate upon impact, in soft snow, however, these fuzes tend to trigger well below the surface and quite probably not until the projectile strikes rock or firm ground. In fact, the ideal point of burst for avalanche release is several metres above the surface in proximity mode. However, with gun fired projectiles, this can only be achieved with an electronic proximity burst fuze. Since this type of fuze is both prohibitively expensive and notoriously unreliable against light, dispersed media such as snow, the performance of impact fuzing continues to be tolerated.

Most areas in ski resorts are accessible, including the mountain peaks, and this accessibility enables explosive charges to be delivered or placed by hand. The practice of positioning charges by hand is probably the most cost effective and extensively used method of avalanche control in many ski resorts, but carries with it obvious hazards in poor weather conditions. The hand charge is a relatively simple device consisting of a lightly cased (cardboard)

explosive charge detonated by a length of capped pyrotechnic delay fuze. The fuze can be ignited and the charge thrown into a preferred position or the charge can be pre-positioned above the surface on a bamboo stick before the fuze is ignited.

It is acknowledged that various types of anti-tank ammunition, bearing shaped charge liners, have been fired into avalanche start zones in the past but this has been as a result of ammunition availability rather than an interest in the shaped charge effect. Results from this type of ordnance, designed specifically for high penetration into steel, has nevertheless been no different from standard artillery fragmenting shells because little of the jet energy can be dissipated into the snow pack.

The present invention seeks to provide an improved hollow charge explosive device for this and other applications.

Accordingly, the present invention provides a hollow charge explosive device including an explosive charge defining boundary walls of a cavity and including particulate material located forward of said boundary walls so as to be dispersible by said explosive charge when detonated.

The particulate material may be included in a liner lining the cavity or positioned elsewhere forward of the cavity, eg in a nacelle, or in both positions.

The particulate material, if present in a liner, is driven in the same way as that of a conventional shaped

charge liner. However, in this case, the particulate medium forms into a highly energetic non-cohesive stream of particles, generally wider than that produced by a conventionally lined shaped charge. In this highly energised state, the low bulk density of the liner material and high surface area attributable to each particle of the liner material, together with the larger surface area of the jets cross section, facilitates an intimate and violent kinetically stimulated reaction with the target medium. Given a knowledge of the intended target material and its constitution, eg a snow slab, the liner material can be chosen to optimise the blast energy yield over and above that normally attributable to the explosive charge alone.

Conveniently, the liner may comprise an inner liner skin and an outer liner skin defining a space therebetween and the particulate material may be a loose powder contained in that space. In a one embodiment, the inner liner skin and outer liner skin are of a glass reinforced plastics material. The particulate material may be aluminium powder, particularly for use in avalanche control due to the potentially highly reactive nature of aluminium powder with water.

In an alternative embodiment, the particulate material may be embedded in an inert binder such as a plastics material, a wax such as a paraffin wax, or an adhesive matrix to aid manufacture, handling and assembly. The matrix material may also be conveniently chosen to make a nett contribution to the reaction of the principal suspended

particulate material.

Where a liner is not present, the high pressure and high temperature gaseous stream produced by the hollow cavity in the explosive focuses blast effects only along the axis of the charge. If a particulate material is located on the axis of the charge, typically in the nacelle, this material will be energised and dispersed by the high pressure and high temperature gases ejected from the cavity, thereby further enhancing the directed blast effects produced by the hollow cavity.

An explosive device assembly may be formed from two such explosive devices oriented such that the jets of liner formed on detonation of the charges are directed towards each other or away from each other.

When the jets are directed toward each other, the collision of the jets with each other provides an energetic response between the interacting jets. Two or more dissimilar liner materials may be provided in the explosive devices which when brought together in collision with each other and/or the target medium achieve an energetic response between associated interacting materials. This effect may also be further enhanced with additional particulate material located in the nacelle.

The devices may be gun fired, or otherwise hand thrown, or form part of a mechanically or chemically launched projectile.

An elongate support may be attached to the explosive charge body to aid hand positioning the device at the



target.

The liner material may take any convenient form which can produce a shaped charge liner collapse mechanism, the so-called "Munroe effect", and typically include conical liner configurations and hemispherical and hemispherical cap geometries.

A method of triggering an avalanche according to the present invention comprises positioning an explosive device or explosive device assembly of the present invention in a predetermined position relative to a snow or ice formation and detonating said explosive device or device assembly.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings of which:

Figure 1 is a diagrammatic sectional view of a first device according to the present invention;

Figure 2 is a diagrammatic sectional view of a second device according to the present invention;

Figures 3, 4 and 5 are diagrammatic views of the results of recent experimental cratering trials conducted against level and stable snow pack;

Figures 6 to 8 are diagrammatic views of the use of an explosive device which is as the device of Figure 1 but with a support stick affixed to it;

Figure 9 is a diagrammatic view of a further embodiment of the present invention for cornice control;

Figure 10 is a further diagrammatic sectional view of a further embodiment of an assembly comprising two devices

of Figure 1;

Figure 11 is a diagrammatic view of a typical application of the device of Figure 10 for avalanche control;

Figure 12 is a diagrammatic sectional view of a further embodiment of an assembly comprising two devices of Figure 1;

Figure 13 is a diagrammatic view of a typical application for the device of Figure 12 for avalanche control;

Figure 14 is a diagrammatic sectional view of a further embodiment of the invention within the body of a modified Avalauncher gas gun round;

Figure 15 is a diagrammatic sectional view of a further application of the explosive charge assembly of Figure 14; and

Figure 16 is a diagrammatic sectional view of a further embodiment of the present invention.

Referring to Figure 1, and explosive device 10 consists of a cylindrical GRP body 2 located between a perspex magazine locating plate 4 and perspex liner locating plate 6. The magazine locating plate 4 centralises a perspex magazine unit 8 on the central axis of the device. The magazine unit 8 locates a detonator 12 and explosive booster pellet 14 to form an initiation cap assembly 16. The initiation cap assembly 16 ensures that the detonation front transferred into a main explosive filling 18, via the booster pellet 14, is propagated symmetrically with respect

to the axis of the device 10. A GRP outer liner skin 22, with an open truncated apex 24 is bonded to the cylindrical body 2 to form a sub-assembly 26. An internal GRP conical liner 32, with a closed truncated apex, is bonded into the recess 34 machined into the liner locating plate 6 to form a sub-assembly 36. Sub-assemblies 26 and 36 are then joined and bonded to form a charge assembly 42 defining a conical void 44 concentric and aligned to the central axis of the device 10.

The material and grist size of a particulate liner cavity filling 45 is chosen to suit the nature of the target material involved. For avalanche control work, aluminium powder of 150 micron particle size is suitable, for example. The filling 45 is loaded into the void 44 through a filling port 24 at the apex of the liner 22. The filling port is then sealed with a disk of aluminium adhesive tape 46. The explosive filling 18 is then loaded into the charge assembly 42 and the charge is closed by fitting and bonding the initiation cap 16 in place. A hole 48 in the liner locator plate 6 allows pressure equalisation between the conical void enclosed by the inner liner skin 32 and liner locator plate 6 and external atmospheric pressure and has no other bearing on the function of the device.

Referring now to Figure 2, a device 20 consists of a cylindrical body 50 located between an initiation cap 16 and a perspex tubular liner assembly locator plate 35. The initiation cap 16 ensures that the detonation front is transferred into a radial detonation transfer disk 51,

symmetrically disposed with respect to the axis of the device 20. An inner GRP tubular liner 52 and outer GRP tubular liner 53 are located co-axially between a polyethylene barrier plate 59 and the tubular liner assembly locator plate 35. The separation between the two tubular liners 52 and 53 is maintained by an insert 54 which is drilled with a single hole 55 to allow a void 56 defined by the liners 52 and 53 to be filled with aluminium powder 58.

The barrier plate 59, inner and outer tubular liners, 52 and 53 respectively, and insert 54 are bonded together to form a tubular liner assembly 57. The void 56 between the inner and outer tubular liners is filled with aluminium powder 58, of 150 micron particle size, through the filling hole 55 which is then sealed with a disk of aluminium adhesive tape, (not shown). The radial detonation transfer disk 51 is bonded to the inner face 58 of the initiation cap assembly 16 and the barrier plate 59 of the tubular liner assembly 57 is bonded concentrically to the outer face 62 of the radial detonation transfer disk 51. A main explosive filling 64 is filled into the charge assembly from the open end opposite the initiation cap 16 and closed and sealed by fitting and bonding the tube locator plate 34 in position.

Figure 3, 4 & 5 show the results of experimental cratering trials of the explosive device of Figure 1 conducted against a level and stable snow pack 66. Each charge was set 1.2m below the snow surface such that its axis was horizontal and the point of detonation 68 arranged such that any bias would be driven in the direction of the

arrow. After firing, the craters were sectioned to reveal the profiles shown in the figures. The depth of the snow base is indicated by a solid black line 72

The profile 74 shown in Figure 3 was produced by a 1kg blast explosive charge 70. The charge was 68 fired to establish a control standard against which the experimental charge firings of devices according to the present invention could be compared. The profile was symmetrical about the vertical axis and yielded a crater volume of 2.7 cubic metres.

The profile 76 shown in Figure 4 was produced by the device 10 described earlier and shown in Figure 1. The explosive content was also 1kg. The effects of the conical liner are clear. The crater was elongated as a result of the penetration and subsequent secondary reaction of the shaped charge jet. A significant increase in the energy transmission into the snow pack was evident, the crater volume increasing from 2.7 to 11.9 cubic metres.

The profile 78 shown in Figure 5 was produced by the device 20 described earlier and shown in Figure 2. The explosive content was also 1kg. This liner configuration produced more localised reaction of the liner material. The crater volume was increased from 2.7 to 7.8 cubic metres. This was less than that produced by the conical liner configuration of device 10 but particularly high shock emission was evident from the ground shock detected and extensive secondary surface spalling at the inner surface of the crater.

There will now be described exemplary applications of the device 10 of Figure 1. It should be note that the applications are equally valid for the device 20 of Figure 2 and liner geometries that fall between the two, the choice being made to suit the characteristics of the particulate loading material, operational environment, cost, and target medium involved.

Figures 6 to 8 illustrate the use of an explosive device 40 which is as device 10 of Figure 1 but with a support stick 82 affixed to it so the device can be positioned and orientated as required on a snow slab. The device 40 includes a pyrotechnic fuze 88. The highly focused blast emission produced by the enhanced blast charge 10 is indicated schematically by the extended, highly schematic "star" shaped blast envelope 84. They respectively illustrate the use of the device for cornice overhang removal with the device 40 providing combined air shock and deep penetration, slab blasting with the device providing combined air shock and deep penetration perpendicular to the snow slab, and slab blasting where the device is orientated to provide superficial disruption of the surface layer of a snow slab.

Figure 9 shows a further use of the present invention for cornice control. The device 50 is as the device 10 of Figure 1 but includes a pyrotechnic fuze 88 and a conical end cap 86 to aid penetration into the soft back of the cornice following remote delivery of the device from a short range launcher system, typically a cross bow.

Figure 10 shows a further embodiment of the present invention, namely an assembly 60 comprising two devices 10 of Figure 1, located back to back within a thin cardboard tube 92. A smaller diameter cardboard tube 94, located inside the main tube 92, holds the devices apart and tape 96 at each end retains the two devices 10 in place. Each device 10 is connected to an identical length of shock tube 98 (Dyno-Nobel Starter Line), terminated at the charge end by an instantaneous standard detonator cap 102. The starter lines 98 pass out of the locating tubes 92 and 94 via hole 104 and are fixed securely to the outer tube 92 by adhesive tapes 106.

The assembly 60 of Figure 10 produces a simultaneous detonation of the charges 10 which project a highly focused axi-symmetric blast wave travelling in opposite directions along the axis of the assembly as indicated by the blast envelope 99.

Figure 11 shows a typical application for the device 60 of Figure 10 for avalanche control. The assembly 60 is arranged to overhang a cornice build up such that the axis of the charge is parallel to the line of the cornice. The two starter lines 98 are initiated simultaneously from a firing point 70 in known manner.

Figure 12 shows a further embodiment of the present invention, namely an assembly 80 comprising two devices 10 of Figure 1, located face to face within a thin cardboard tube 108. A smaller diameter cardboard tube 112, located inside the main tube 108, establishes a separation between

the charges 10 that can be changed in length to alter the output of the charge assembly. The charges 10 are retained in the outer tube 108 by adhesive tape as described for Figure 10. Each device 10 is connected to an identical length of shock tube 114 (Dyno-Nobel Starter Line), terminated at the charge end by an instantaneous standard detonator cap 116. The two starter lines are then crossed over the outer tube 108 and taped securely as described for Figure 10.

The assembly 80 of Figure 12 produces simultaneous detonation of the charges. When the jets formed by the two shaped charge liners collide, in accordance with simple principles of momentum balance, a symmetrical 360 degree disk of high pressure products 109 is emitted in a plane at 90 degrees to the axis of the two charges.

Figure 13 shows a typical application for the device of Figure 12 for avalanche control. The assembly 60 is arranged to overhang a cornice build up such that the axis of the charge is parallel to the line of the cornice. The two starter lines 98 are initiated simultaneously from the firing point 70. This arrangement may be equally effective if suspended such that the axis of the assembly 80 runs vertically.

Figure 14 shows an embodiment 90 of the current invention within the body of a modified Avalauncher gas gun round 90. An assembly 125 consists of a plastics nose cone 118, a full calibre body shell 119, containing the explosive filling 122, and an enhanced blast shaped charge liner



assembly 123, as described for device 10 of Figure 1, and a plastics tail fin adaptor 124 of known form. The explosive charge assembly 125 is stored separately from a known tail fin assembly 126, which embodies the safety and arming mechanism (not detailed) and detonator 128. This configuration significantly improves the performance of the standard Avalauncher blast round as shown in Figures 3 and 4, respectively.

Figure 15 shows a further embodiment 100 employing the above explosive charge assembly 125 but this time in conjunction with the shock tube firing and control system described in detail filed in copending British Patent Application No 9915586.3 the entire contents of which are incorporated by reference into this application. This embodiment 100 is a cost effective engineering solution, for application of the experimental configurations described in Figures 1 and 2, to hand charge avalanche control operations. Briefly, the free end 132 of a Dyno-Nobel starter line is attached to the operator (not shown). The remainder of the starter line is coiled as a coil 134 within a cardboard spool tube 136, eventually terminating at a detonator end 138 forming a spool assembly 142 which is retained 144 on the body of the Avalauncher explosive charge assembly 125 by adhesive tape 144. The charge assembly 100 may be thrown or launched to the desired position, the first end 132 of the starter line being subsequently detached from the operator and connected to a firing pack (not shown) ready for firing.

Referring now to Figure 16, this embodiment of the present invention is a round 150 having a body 152 and nacelle 154, both of injection moulded polypropylene, joined together by a joint ferrule 156, also of polypropylene, held together by pairs of male/female clip rings (not shown) moulded into the three components 152, 154, 156.

The body 152 is tapered to minimise aerodynamic drag and has the necessary base features to interface with previous described aerodynamic fin 126 and firing assembly of Figure 14.

The nacelle also provides aerodynamic streamlining and a stand off between the mouth of a shaped charge liner 158 and target material (not shown). Alternative nacelle shapes could be employed to control the detonation delay time in soft snow pack, for example.

The joint ferrule 156 also retains the liner 158 and a series of HE pellets  $HE_1$  to  $HE_6$  within the body component. Note that there is a 1mm clearance gap between the liner 158 and joint ferrule 156 to accept a soft packing washer 160 to control thermal effects and tolerance build-up.

The liner 158 is pressed from aluminium powder bound with paraffin wax, this allows a broad range of different liner compositions to be introduced to adjust performance to suit varying conditions and/or alternative applications. A range of different liner geometries can also be used for the  $HE_1$  pellet. The liner 158 of this embodiment has a density of 1.7g/cc.

The explosive charge consists of a set of pre-pressed

pellets HE<sub>1</sub> to HE<sub>6</sub>. This construction allows a range of different explosive compositions to be introduced to adjust performance to suit varying conditions and/or alternative applications. Typically, aluminised explosive (addition of up to 20% of Al. powder) significantly enhances blast yield from pellets HE<sub>3</sub>, HE<sub>4</sub>, HE<sub>5</sub> and HE<sub>6</sub>, but pellets HE<sub>1</sub> and HE<sub>2</sub> could be a high density HMX and/or RDX/wax composition, more ideally suited to the shaped charge function. However, all pellets (HE<sub>1</sub> to HE<sub>6</sub>) could be aluminised to optimise blast yield.

A wave shaping barrier 162 (injection moulded polypropylene) shapes the geometry of the detonation from and influences the way in which the shaped charge liner collapses. A broad range of different effects can be both introduced and controlled by altering the shape of the barrier 162. The introduction of a separate pellet that accommodates the barrier feature pellet HE<sub>2</sub> allows for such changes to be made at will.

The nacelle 154 has a bead 168 round the inside of the nacelle 154 tapered rearwardly to permit a bowed plenum 166 to be pushed forwardly over the bead 168 and held in position inside the nacelle 154.

The front most region of the interior volume of the nacelle 154 is filled with aluminium powder 164 and held in place by the plenum 166 but other materials can be placed there, eg aluminised paraffin wax.

A throughhole 172 in the nacelle 154 allows the injection of a low density filler, eg polyurethane foam,

about  $0.01\text{gm/cm}^2$ , to fill the volume 170 which is in the collapse zone forward of the liner 158. This adds rigidity to the forward structure of the device and provides support to the liner 158 so permitting the use of more frangible liners than otherwise possible.

The material 164 in the nacelle 154, if present, is energised, dispersed and propelled forward by the jet formed on detonating the device, to react with either the target material and/or the atmosphere ahead of the nacelle.

An alternative embodiment of the device of Figure 16 is one in which there is no particulate material 164. In a further embodiment, the liner 158 may be omitted, with suitable dimension changes of the pellet  $\text{HE}_1$  to accommodate the gap that would otherwise be present between it and the washer 160 or replaced by a liner not having any dispersible material in its composition. Such an embodiment would be applied where minimal penetration effects were required, typically, the production of a highly directional gaseous blast effect. The magnitude of the focused blast effect could be further enhanced by causing the gaseous jet formed by the cavity in the explosive to interact with a particulate or reactive material 164 contained within the nacelle.

Although the use of present invention has been described in terms of avalanche control applications, the benefits of controlled and highly directional cutting, perforation or stimulation of secondary reactions of explosive devices according to the present invention has a

wide range of other potential applications. These include:

rapid generation of wide access holes in concrete/rock walls in support of rescue and recovery operations, where a range of liner materials and particle sizes for the liner can be chosen to control the nature of the cut and/or residual particle penetration into sensitive areas behind;

the use of directing the highly focused blast effects to combat and extinguishing burning oil wells;

rapid internal cutting of narrow bore, thick walled pipes, typical of well liners and drilling shafts; and

spalling of loose rock from chamber roofs in underground mines, civil tunnelling and mining operations and underwater engineering operations.

While this invention has been particularly shown and described with references to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

CLAIMS

1. A hollow charge explosive device including an explosive charge defining boundary walls of a cavity and including particulate material located forward of said boundary walls so as to be dispersible by said explosive charge when detonated.

2. A device as claimed in claim 1, in which said particulate material is included in a liner, said liner lining said cavity.

3. A device as claimed in claim 2, in which said liner comprises an inner liner skin and an outer liner skin spaced apart from said inner liner skin, and said particulate material is a loose powder located between said inner liner skin and said outer liner skin.

4. A device as claimed in 3 in which said inner liner skin and said outer liner skin are formed from a glass reinforced plastics material.

5. A device as claimed in any preceding claim, in which said particulate material is embedded in a solid binder.

6. A device as claimed in any preceding claim, in which said particulate material has been consolidated by mechanical pressure.

7. A device as claimed in any preceding claim, in which said particulate material is aluminium powder.
8. A device as claimed in any preceding claim in which said particulate material is a chemical or is a composition which reacts with a predetermined target medium.
9. A device as claimed in any preceding claim including a nacelle forward of said cavity, particulate material being located in said nacelle.
10. An explosive device assembly including two explosive devices, each as claimed in any one of claims 1 to 9, said two explosive devices being oriented such that the jets formed from said liners on detonation of the charges are directed towards each other.
11. An explosive device assembly including two explosive devices, each as claimed in any one claims 1 to 9, said two explosive devices being oriented such that said jets formed from said liners on detonation of said devices are directed away from each other.
12. An explosive device assembly as claimed in claim 10 in which the collision of said jets with each other provides an energetic response between the interacting jets.

13. An explosive device assembly as claimed in claim 10 or 12 in which each explosive device includes a respective liner, each of said liners including a material not present in the other liner materials, said materials being such that when brought together in collision with each other and/or a target medium an energetic response between associated interacting materials is achieved.

14. An explosive device as claimed in any preceding claim, which is embodied in a gun firable or hand throwable, or mechanically or chemically launchable projectile.

15. An explosive device as claimed in any preceding claim 1 in which the device includes a liner which liner includes aluminium powder bound with wax.

16. An explosive device as claimed in claim 15 in which the wax is paraffin wax.

17. An explosive device as claimed in any preceding claim in which the explosive charge includes two or more high explosive pellets.

18. An explosive device as claimed in claim 17 in which one or more of the high explosive pellets is aluminised.

19. A method of blasting a target including a given material comprising, providing an explosive device as

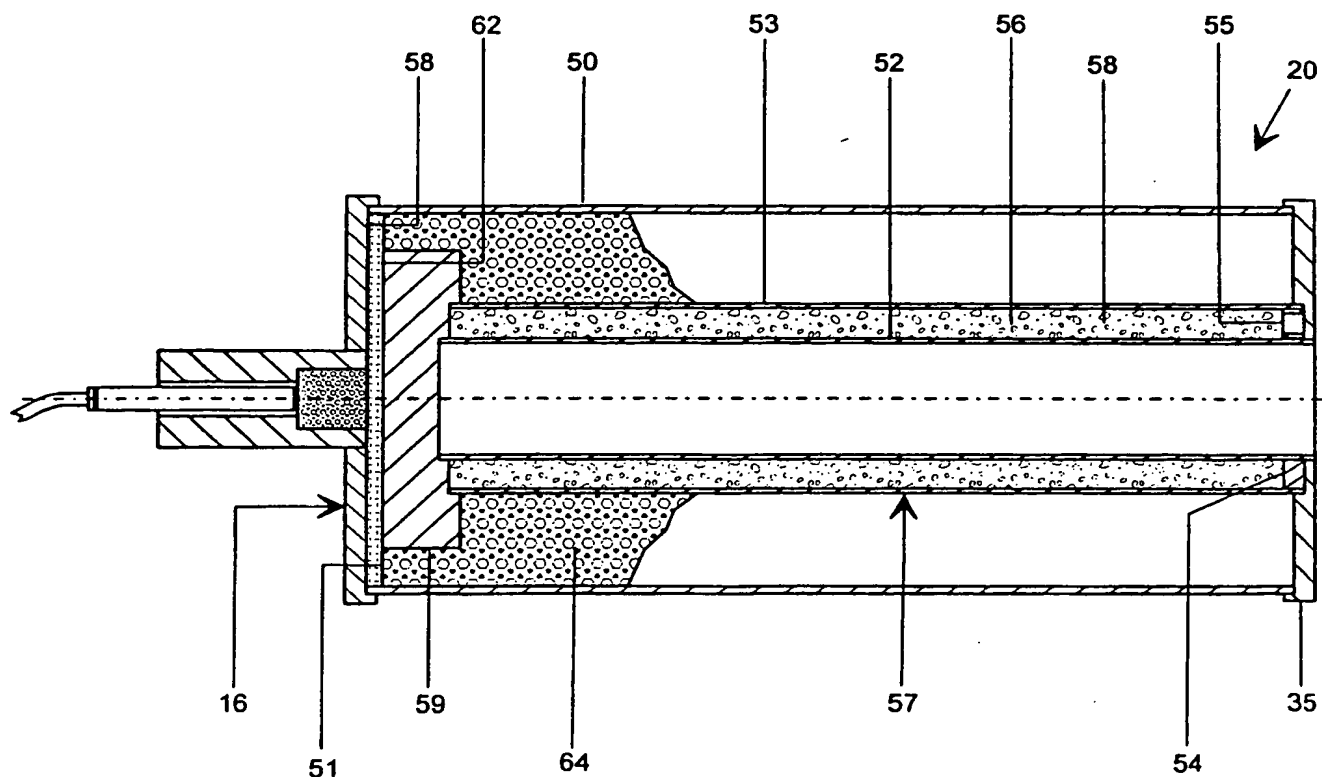
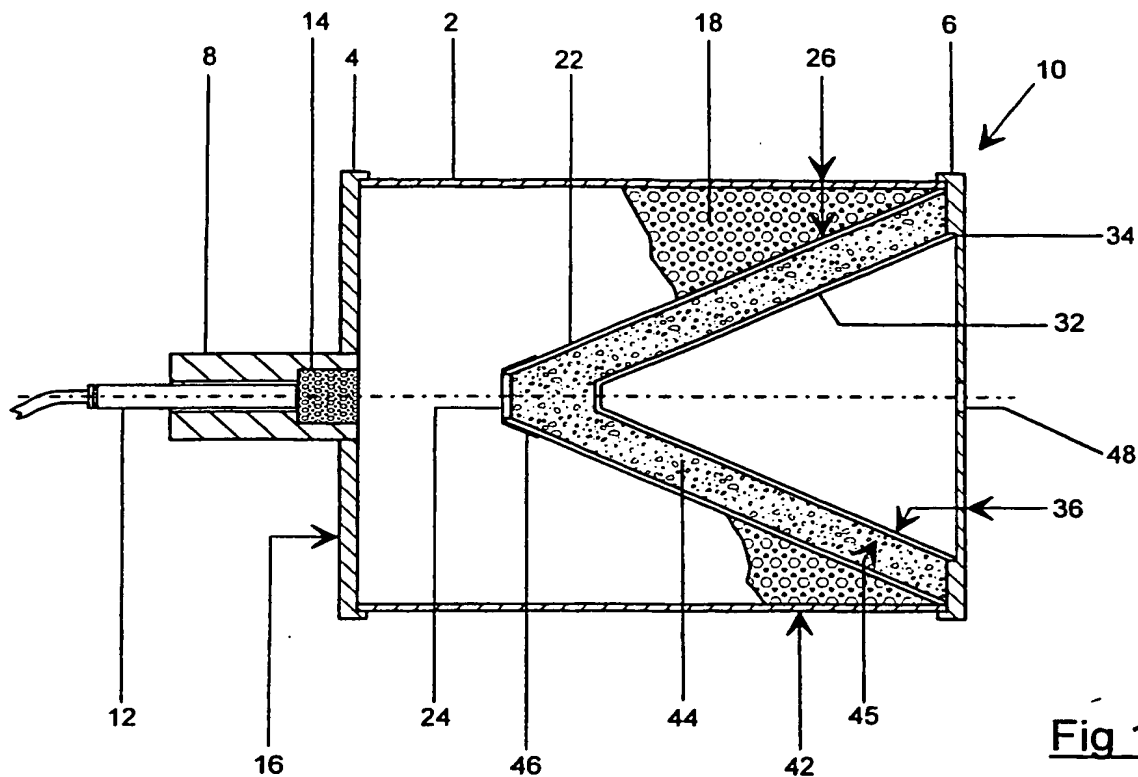


claimed in any one of claims 1 to 18, said particulate material being selected to be one which reacts with the said material of the target on detonation of the explosive device, and detonating said explosive device.

20. A method of as claimed in claim 19 comprising positioning said explosive device in a predetermined position relative to a snow or ice formation target, and detonating said explosive device thereby triggering an avalanche.

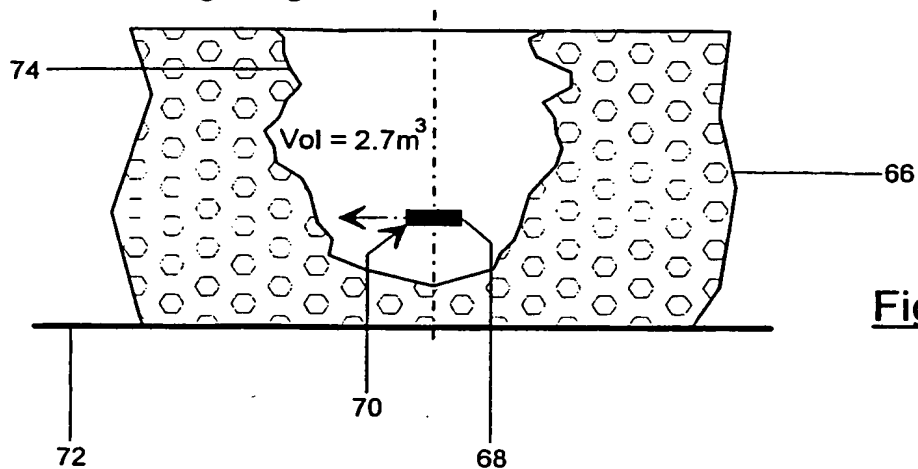
21. A method as claimed in claim 19 or 20, in which said explosive device is positioned by launching said explosive device by hand or by mechanical or chemical propulsion.

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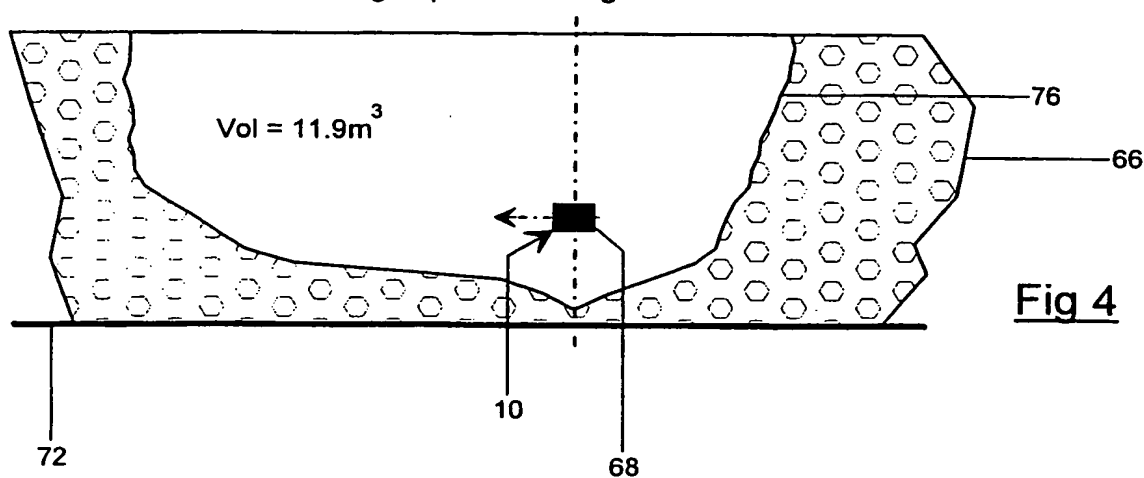


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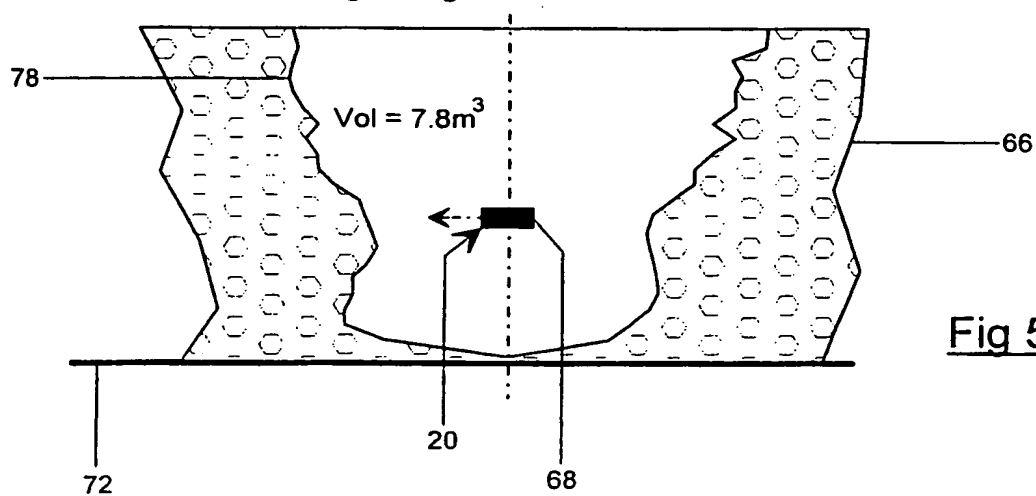
1kg charge - Standard Avalauncher Round

Fig 3

1kg explosive charge - conical liner

Fig 4

1kg Charge - Tubular liner

Fig 5

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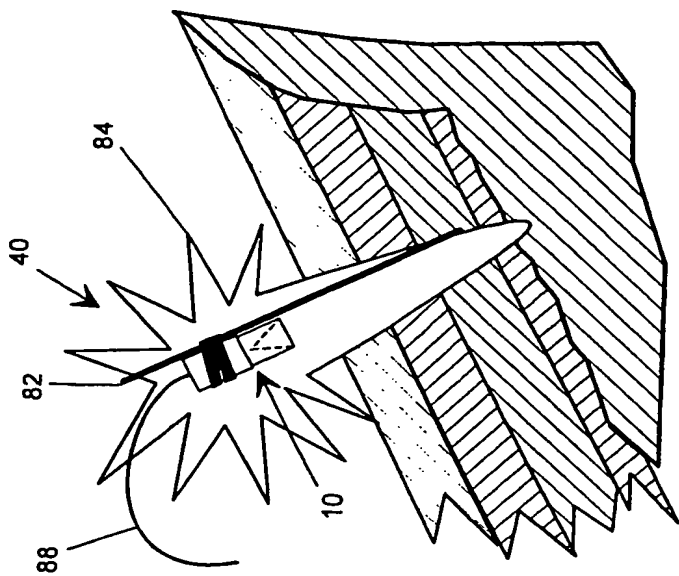


Fig 7

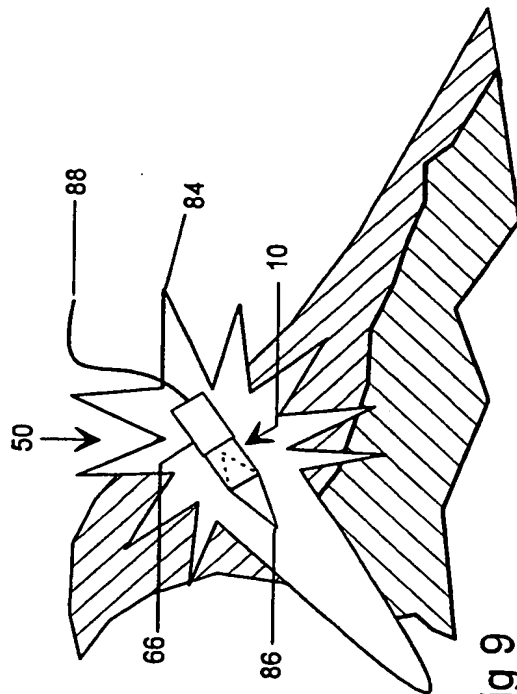


Fig 9

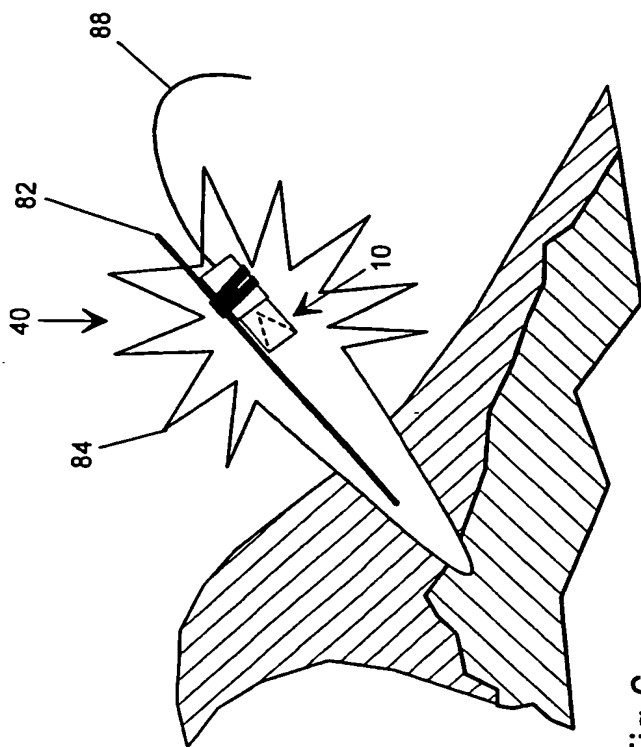


Fig 6

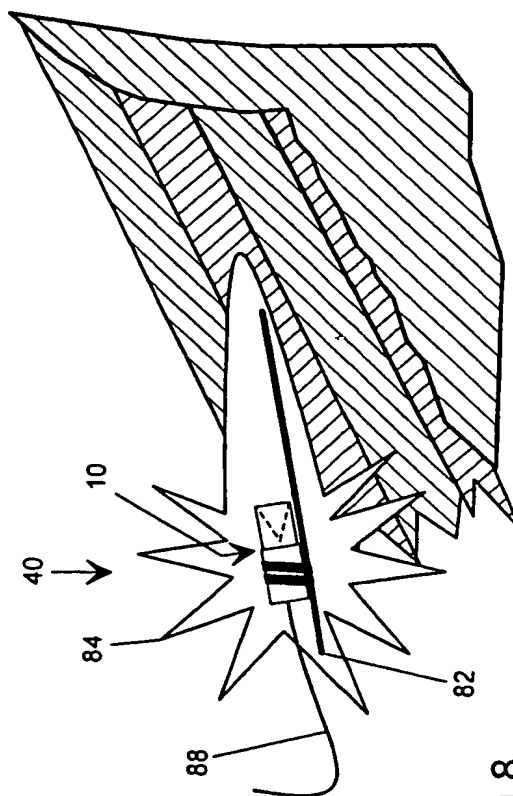


Fig 8

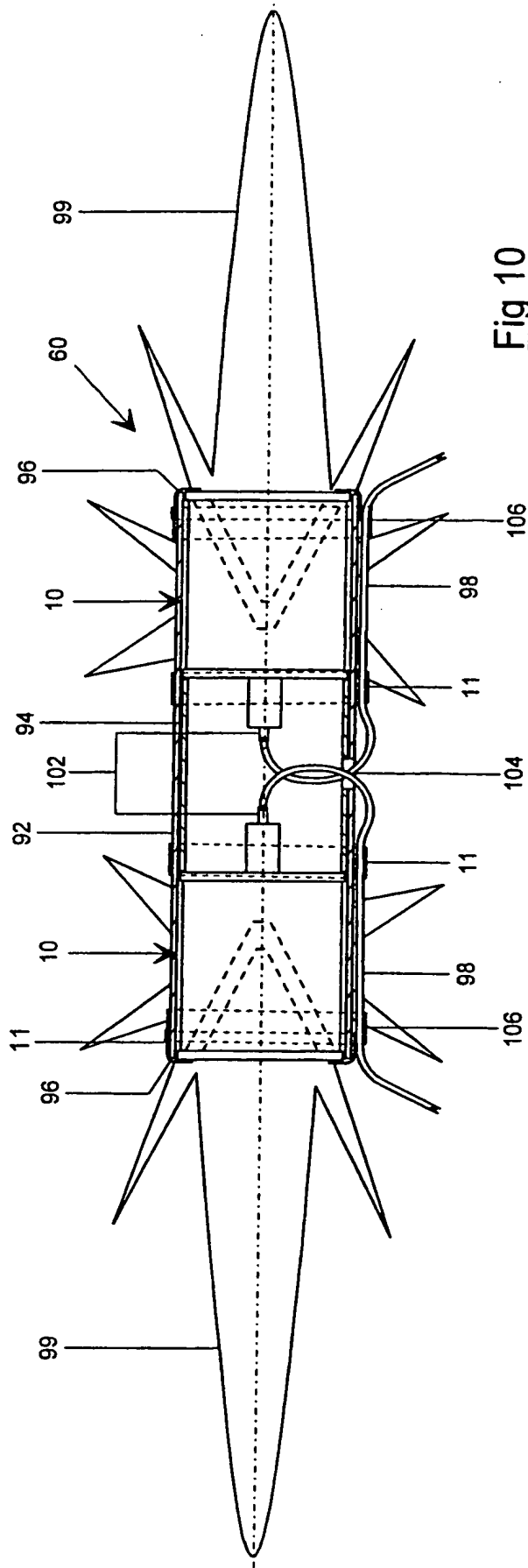


Fig 10

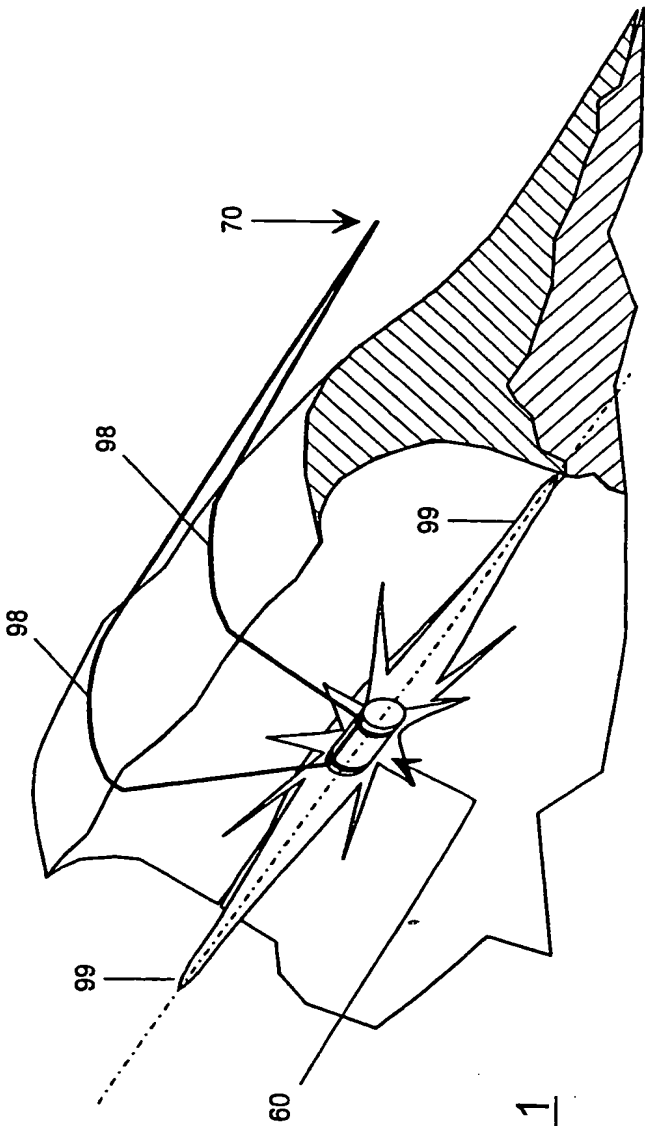


Fig 11

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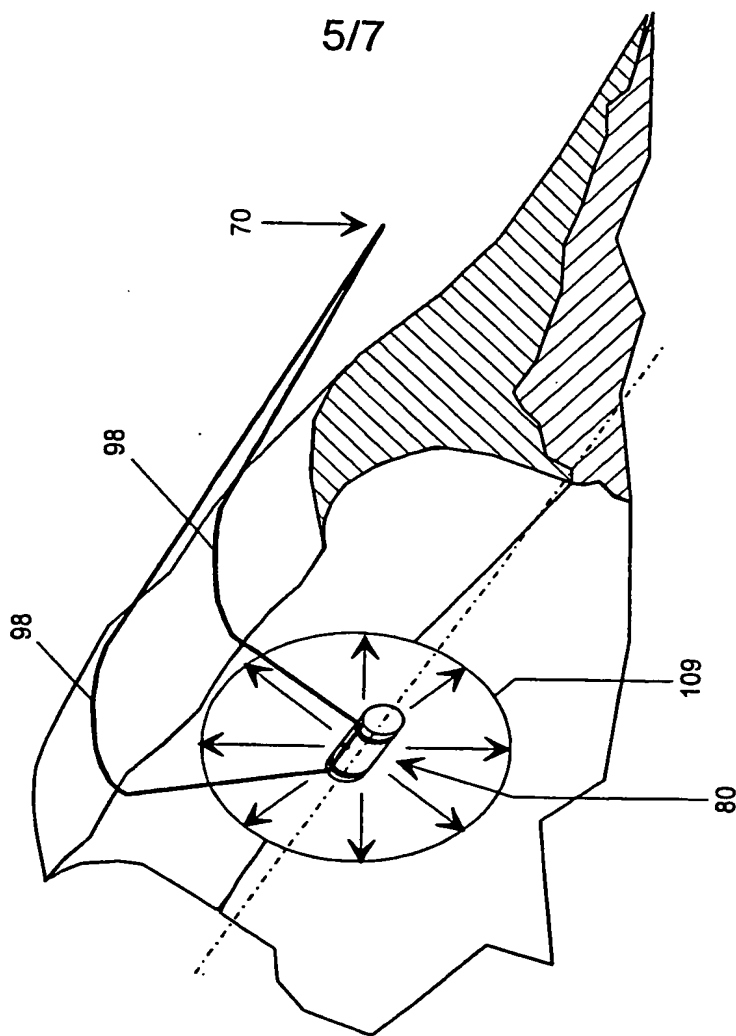


Fig 13

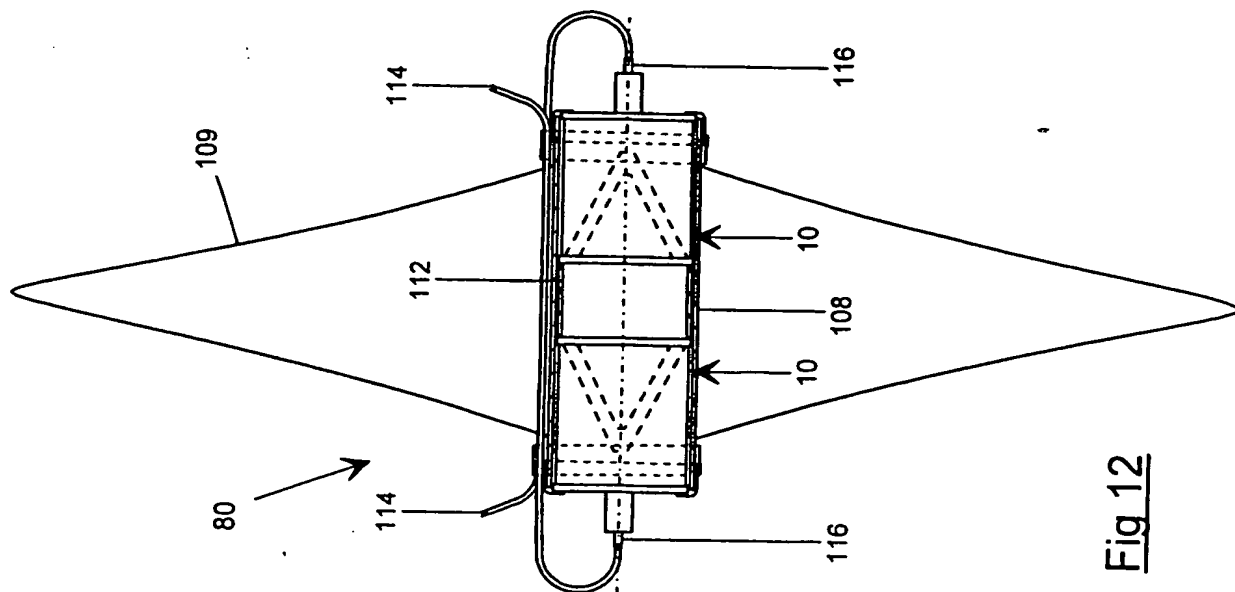
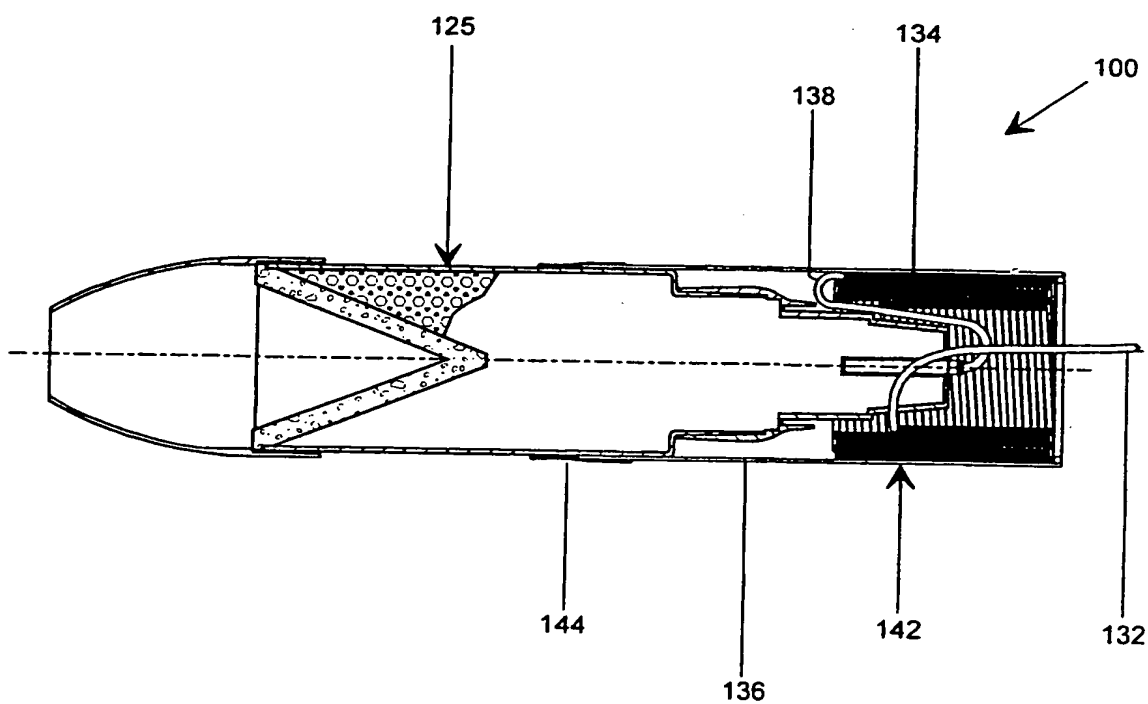
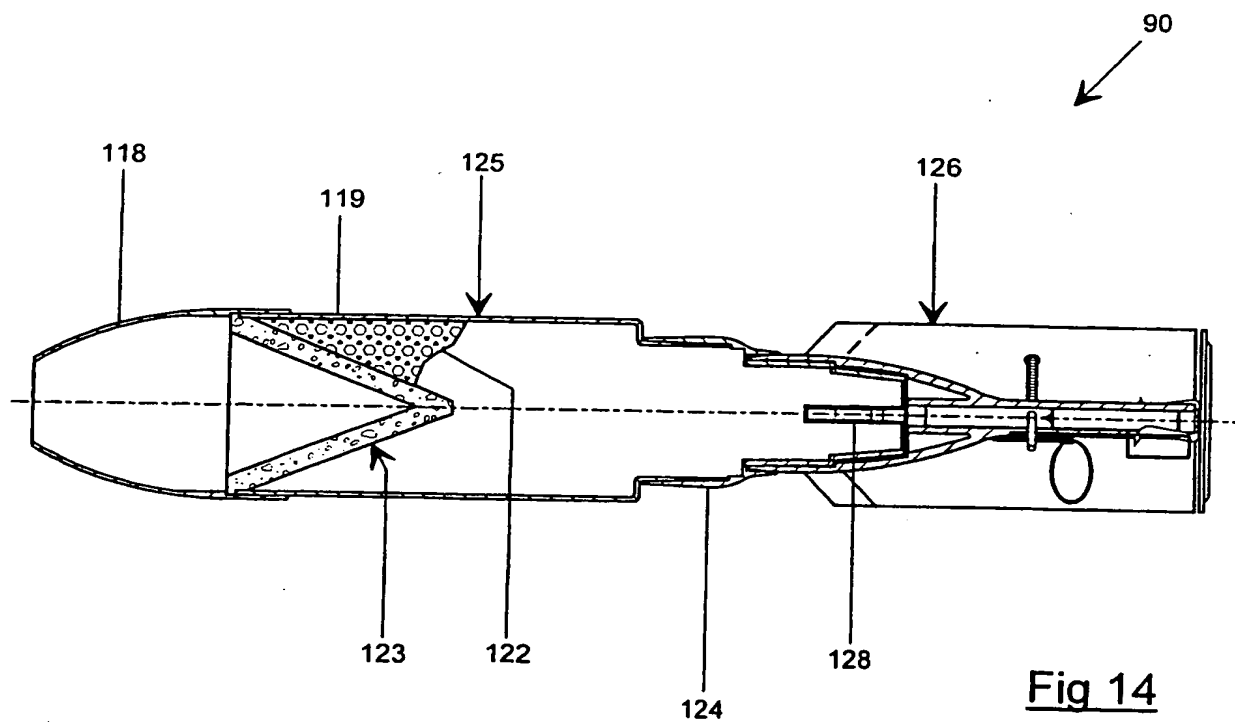


Fig 12

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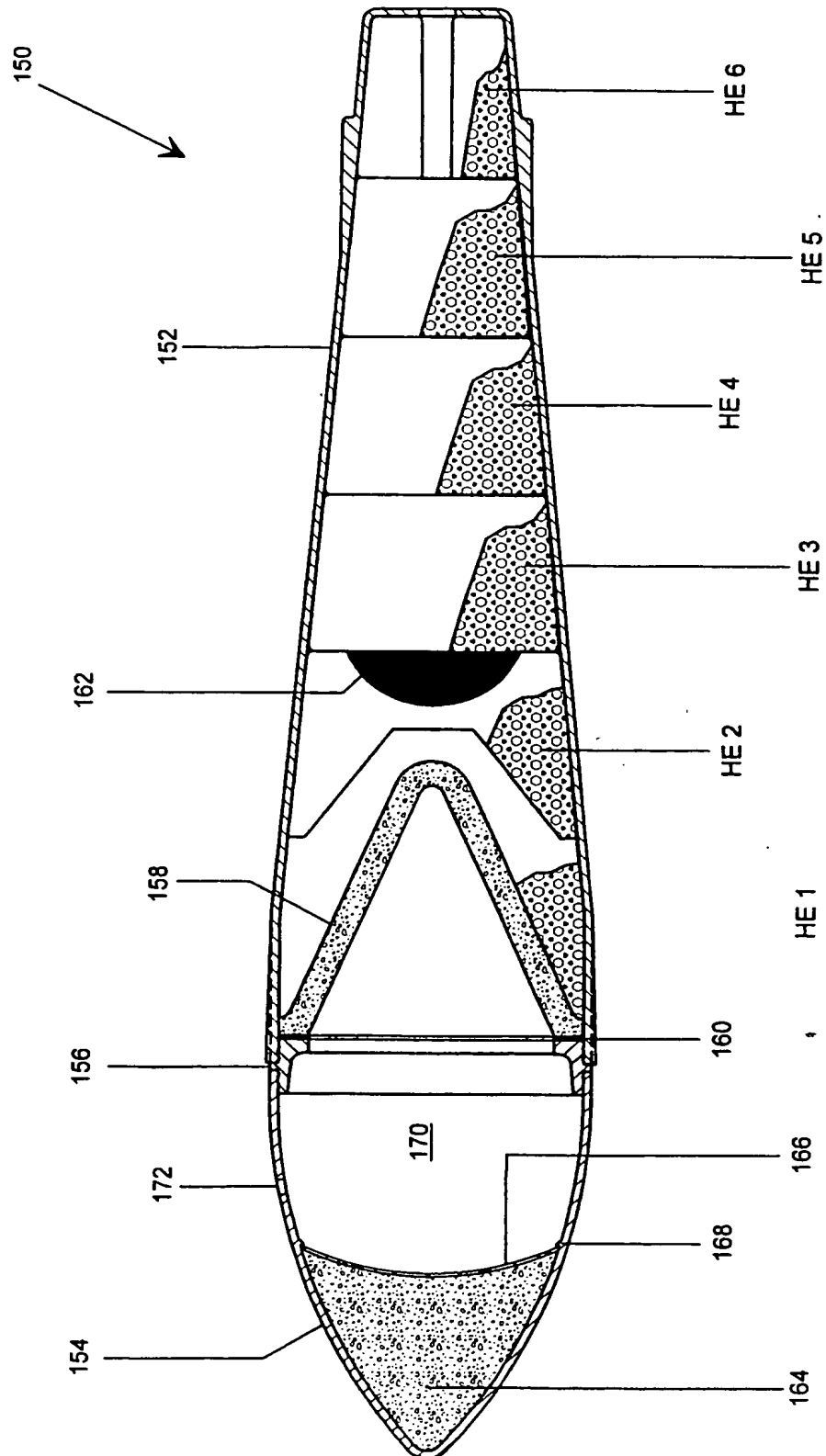


Fig 16